

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Masaru HIDAKA et al.

5 Serial No.: 10/593,081 Art Unit: 1796
Filed: September 15, 2006 Examiner: Frances Tischler
For: METHOD OF DECOMPOSING PLASTIC

DECLARATION OF UNDER 37 C.F.R. 1.132

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Honorable Commissioner of
Patents and Trademarks
Alexandria, VA 22313-1450

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I, Takaharu NAKAGAWA, residing at 2-16-19 Kikumidai,
Heguri-cho, Ikoma-gun, Nara, Japan, declare and say as
follows:

1. I am one of the joint inventors of the above
identified application;

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2. I graduated from the Department of Chemical
Engineering, Faculty of Engineering, Kobe University, Hyogo,
Japan in March 1981 and received a Master Degree in Chemical
Engineering from the Graduate School of Kobe University in
March 1983;

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3. Since April 1983 to the present, I have been
employed by Panasonic Electric Works Co., Ltd., the former
Matsushita Electric Works, Ltd. Since 1983 to 2001, I was
engaged in the research works on the development of energy
equipment-related technology, garbage processor-related
30 technology, deodorization treatment-related technology, and
so on. Since 2001 to the present, I have been engaged in
the research works on the development of FRP recycling
technology.

4. I read the Office Action issued on December 17, 2008
35 in the above identified application and the prior arts cited
therein.

Then, I carried out experiments for showing that the effects of addition of base in the decomposition of uncrosslinked unsaturated polyesters are different from those in the decomposition of crosslinked unsaturated polyesters in the Examples of the present application, namely, in the decomposition of a thermosetting resin having a matrix structure containing crosslinking moiety according to the present invention, the addition of base can produce dramatic effects, in addition to acceleration of hydrolysis of ester linkages in the polyester main chain.

I beg to report the results of the experiments below.

Experiment

(Experiment 1)

A varnish of unsaturated polyester comprising a glycol and an unsaturated organic acid, obtained by removing styrene from a viscous liquid of uncrosslinked unsaturated polyester resin ("Rigolac M540" manufactured by SHOWA HIGHPOLYMER CO., LTD.) by vaporization, was used as a test sample.

The unsaturated polyester (0.85 g) and pure water (15 g) were charged into a reaction tube 1, and immersed in a constant temperature bath 2 of a temperature of 230°C to thereby put the pure water in the reaction tube 1 into a subcritical state. The reaction tube 1 was left to be immersed in the bath 2 to thereby treat and decompose the unsaturated polyester for 4 hours. After that, the reaction tube 1 was removed from the bath 2 and was then immersed in a cooling bath 3 to thereby rapidly cool the reaction tube 1 to room temperature.

The content in the reaction tube 1 after the decomposition treatment was only a water-soluble component, and no residue was present. The decomposition percentage

was 100%. Then, the amount of a glycol monomer component was determined from the water-soluble component by gas chromatography (GC analysis), and the glycol recovery percentage was calculated from the result. The amount of an
5 organic acid monomer component was determined by ion exchange chromatography (IC analysis), and the organic acid recovery percentage was calculated from the result. The results are shown in Table A.

(Experiment 2)

10 The decomposition treatment was carried out in the same manner as in Experiment 1, except that an aqueous KOH solution (KOH concentration: 0.2 mol/l) was used instead of pure water. Also, the decomposition percentage, the glycol recovery percentage, and the organic acid recovery
15 percentage were calculated in the same manners. The results are shown in Table A.

(Experiment 3)

The decomposition treatment was carried out in the same manner as in Experiment 1, except that an aqueous KOH
20 solution (KOH concentration: 0.5 mol/l) was used instead of pure water. Also, the decomposition percentage, the glycol recovery percentage, and the organic acid recovery percentage were calculated in the same manners. The results are shown in Table A.

25 (Experiment 4)

The decomposition treatment was carried out in the same manner as in Experiment 1, except that an aqueous KOH
solution (KOH concentration: 1.0 mol/l) was used instead of pure water. Also, the decomposition percentage, the glycol
30 recovery percentage, and the organic acid recovery percentage were calculated in the same manners. The results are shown in Table A.

[Table A]

| | Exp. 1 | Exp. 2 | Exp. 3 | Exp. 4 |
|---|---------|-----------|-----------|-----------|
| Reaction temp. | 230°C | 230°C | 230°C | 230°C |
| Pressure | 2.8 MPa | 2.8 MPa | 2.8 MPa | 2.8 MPa |
| Treating time | 4 hrs. | 4 hrs. | 4 hrs. | 4 hrs. |
| Base | None | KOH | KOH | KOH |
| Concentration | | 0.2 mol/L | 0.5 mol/L | 1.0 mol/L |
| Number of moles of alkaline salt to theoretical number of moles of acid residue in Compound [1] ^{*1} | 0 | 1.9 | 4.8 | 9.6 |
| pH before reaction | 9.4 | 13.2 | 13.6 | 13.9 |
| pH after reaction | 2.5 | 3.8 | 4.7 | 13.5 |
| Decomposition percentage | 100 | 100 | 100 | 100 |
| Recovery percentage of glycol | 58.5 | 86 | 90.6 | 80.7 |
| Recovery percentage of organic acid ^{*2} | 84.9 | 62.4 | 86.9 | 94.1 |
| Formation percentage of Compound [1] | - | - | - | - |

*1: The unsaturated polyesters in Experiments did not contain structures corresponding to Compound [1], since they were obtained by removing styrene from Rigolac M540. These values were calculated on the assumption that two-thirds of the total amount of fumaric acid residues in the unsaturated polyester constituted structures corresponding Compound [1].

*2: The organic acid recovery percentages in Experiments were greater than those obtained in the Examples of the present application. This was due to that the unsaturated polyesters used in Experiments did not contain structures corresponding to Compound [1], and therefore, all of the organic acids to be recovered were recovered as a monomer.

The undersigned declares further that all statements made herein of this own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so that made are punishable by fine or imprisonment, or both, under 18 U.S. Code 1001 and that such willful false statements may be jeopardize the validity of this application or any patent issuing thereon.

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Takaharu Nakagawa

Takaharu NAKAGAWA

Dated this 12 day of May, 2009